DOCUMENT RESUME

ED 184 100 CS 005 351

AUTHOR Estes, Thomas H.; Shebilske, Wayne L.
TITLE Comprehension: Of What the Reader Sees of What the Author Says.
PUB DATE 79
NOTE 14p.; Paper presented at the Annual Meeting of the National Reading Conference (29th, San Antonio, TX, November 29-December 1, 1979).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Content Area Reading; *Discourse Analysis; *Reading Comprehension; *Reading Processes; *Reading Research; Research Methodology; *Structural Analysis (Linguistics)
IDENTIFIERS *Schemata

ABSTRACT

One of the major assumptions of recent reading research has been that what the reader sees in the text plays as heavily in determining comprehension as does what the author says in the text. Although most researchers have tended to infer the reader's contributions by noting the differences between text structure and recall structures, there have been efforts to develop tools to quantify what the reader sees in the text. These efforts began with attention to a text's formal structure as the reader sees it and to the world knowledge of the reader presumed by the text. Four behavioral measures have been proposed for approaching text as a product of readers' perceptions: having readers mark off "idea units" in the text to determine where and how readers organize texts; rating these idea units as important/unimportant to the author's main points; recording the immediate recalls of what has been read; and rating the importance of propositions ensuing from dependency analyses. Research dependent on these measures has begun, using college students as "expert readers"; and the interrelationships among the data suggest interesting connections between the manner in which students perceive text structure and the structure of their comprehension. (RL)

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Thomas H. Estes,
Associate Professor
University of Virginia
Ruffner Hall
405 Emmett Street
Charlottesville, VA 22903

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Comprehension: Of What the Reader Sees of What the Author Says

Thomas H. Estes and Wayne L. Shebilske
University of Virginia

This paper derives from an NIE/NSF jointy funded project designed to develop some basic understandings concerning the relationships between the conceptual structure of textbooks and the quality and processes of comprehension. Many students have difficulty learning from the textbooks of content courses, though sometimes the students are otherwise seemingly good readers. At least two plausible explanations

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might be offerred for this. For one, it is possible that most of the materials in which student have learned to read possess a narrative structure, while those in which they are now asked to read to learn are characterized by an expository structure which makes different demands on the reader. After several years of being taught to read in anthologies of stories, students may have tacitly internalized "grammars" for stories, strategies of comprehension not dissimilar in principle from those which researchers such as Rummelhart (1977) have explicated in the form of narrative rules. The expository and quasi-technical writing in text books, particularly at upper grade levels, may not easily yield to such rules.

Another explanation is that the world knowledge demands placed on students by their content area reading are prohibitively great. Narration, with its major purpose of effect rather than information, would seem to make relatively fewer such demands. If so, this might argue for its choice as the style for teaching very young readers, but the question remains, how are students to understand the more difficult expository form of textbooks whose major purpose is to inform. Our working hypothesis is

that the answer to this question will be found in an explication of what Walter Kintsch (1979) has called an "interactionist" view of reading. Our hope is to contribute to this explication.

The base of research from which one begins to investigate the process of comprehension is quite solid. Two particular features characterize research in comprehension and retention of prose in this decade and distinguish it from previous work. The last ten years have witnessed a change from surface structure analysis of text to the analysis of semantic structure, concomitant with a switch to open-ended or minimally cued recalls in preference to answers to specific questions as a measure of comprehension (cf. Marshall & Glock, 1978). These shifts reflect a widespread view that there are (1) identifiable structures of text, generally specificable in propositional terms, and (2) structures of thinking, hypothesized about in relation to cognitive structure (Ausubel, 1968) and schema theory (Anderson, 1976), which both have an effect on comprehension and, indeed, may together play a determining role with respect to comprehension. One of the major assumptions to which this leads is that what the reader <u>sees</u> in the text plays as heavily in determin-

ing comprehension as does what the author says in the text. In philosophical terms, this idea is congruent with the phenomenological perspective on reading advanced most recently and persuasively by Wolfgang Iser in his book, The Act of Reading (1978): ". . . the study of a literary work should concern not only the actual text but also, and in equal measure, the actions involved in responding to that text " pp. 20-21. (For a briefer and easily apprehensible discussion of Iser's ideas see Iser, 1974, or Iser, 1971.)

Much notable recent research has rested on ideas similar to these (Thorndyke, 1977; Rummelhart, 1977; Kintsch and Van Dijk, 1976; Frederickson, 1975). In general, however, most researchers have sought to infer the contribution of the reader by looking for differences between the structure of text and the structure of recall. One of our major attempts to extend this line of inquiry will be to develop tools to quantify what the reader sees in the text. We seek to advance the operation of text analysis by giving it the power to account as directly as possible for the contribution of the reader to the structure of text. Though we are utilizing for-

mal analyses of text structure, the emphasis of our research is on the structure of text as readers perceive it.

Our work has begun with textbooks in science. We have specified in propositional terms the formal structure of excerpts from three biology textbooks, one at the seventh grade level, one at the tenth grade level, and one at the college level, all concerned with the classification of species. (We have employed a dependency analysis proposed by Deese (1979) which yields a propositionally-based hierarchical explication of text.) From these analyses, two important though not unexpected findings have emerged. First, the passages differ in their depth. The seventh grade passage has no proposition deeper than the sixth level. In contrast, the tenth grade passage has propositions as deep as the twelfth level. Second, the texts differ in the extent to which they demand inferences on the part of the reader, the extent to which information is presented ambiguously, and the extent to which the organization of the presentation follows an inductive or a deductive path. For example, the subsection of the tenth grade text entitled "Meaning of species" begins with a particular

example, the "many intermediate mongrels between such different breeds as Great Danes and greyhounds". The first paragraph ends, "Therefore, all dogs are grouped into a single species." The full section ends with a one sentence definition of species as its summary. The general problem of speciation is buried in the text and in the hierarchy of propositions which describe it. Other sections are even more extremely inductive, and the reader is often left to infer very major ideas. These show up as parenthetical propositions in the formal analysis. By contrast, however, the corresponding section of the college text, entitled "What is a species?", begins with a definition. Similarly, other sections tend to begin immediately with general principles, and thus the organization of the text is such that the topical statement is formed of very high order propositions. Exactly how this may effect what the reader sees in the text is one of our major questions. In technical terms, this relates to the grammars assumed by different expository structures.

Our formal analyses are also directed at the problem of world knowledge presumed by text. Though lower level texts typically have less depth of structure than higher level texts, this is not

invariably so. For example, the excerpts on the classification of species are atypical because the excerpt from the college text has a shallower structure than the excerpt from the tenth grade text. Yet our intuitions suggest that the college excerpt is actually more complex to understand. The beginnings of an answer to this enigma are found in consideration of the part of the specific body of knowledge presented by each text. The college text relates the notion of species to the theory of evolution; the tenth grade text does not, the authors having chosen to treat evolution as a separate topic. Hence, the information presented in the college text must be related by the reader to a larger conceptual structure which is mostly assumed by the author. The difference between the two texts is no simple matter of sentence complexity, word frequency, or even propositional content. It is rather, at least in part, a matter of what we might call "textual presumption", the relationship between the conceptual structure of each text and the structure of an entire body of knowledge about biological classification. It is part of our goal to adopt the use of formal analyses in a manner which allows us to capture this important conceptual feature of texts.

The complement to these formal measures of text properties, and the dimension of our research allowing an approach to text as a product of readers' perceptions, thus far has taken the form of four interrelated behavioral measures. Initial data were drawn on college subjects; similar measures are currently being taken on students at seventh and tenth grade levels. The data reported here were derived from college students' reading of our tenth grade passage. College students have served, in effect, as expert readers and it is from data drawn on their reading of the tenth grade text that we expect to drive hypotheses concerning other students' reading of materials appropriate to their grade placement. These are our four measures: One, we have asked students to mark "idea units" in the text and we have analyzed these markings to determine where the texts divide into such units. Two, we have asked a group of students to rate these idea units as important or unimportant with respect to the author's main points. Three, we have asked a group of students to read the passage and to record immediately their recall of what they read. And, four, we have asked a group of college students

to rate the importance of the propositions ensuing from our dependency analysis with respect to the author's central message. Interrelationships among these data suggest interesting connections between the manner in which students perceive and act on text structure and the structure of their comprehension.

One immediately interesting finding is that formal and behavioral measures may differ in the picture of text they afford. Any formal analysis must be specificably and predictably rule governed, by definition, and in that degree it must be rigid. Behaviors of readers, though, are governed by more flexible rules, rules which are tacit and unspecifiable in principle. This can result, for example, in some high level propositions being given low importance ratings and in some low level propositions being given high importance ratings. Most obviously, this occurs when good readers perceive the importance of subsidiary propositions which are main ideas.

Our procedure for determining the idea units in a text are interestingly simple but complexly justified mathematically (Rotondo, 1979). Basically, the problem we faced was in knowing how many idea units a passage contained and where the breaks between units came. To answer the first question, we

relied on the arithmetic mean of idea unit markings which subjects used. That is, our best guess of how many ideas the text contained was the average number of ideas marked. To answer the second question, we calculated the percentage of subjects agreeing on each possible idea unit break, ranked the possible breaks on that basis, and then merely counted off the number of ideas our averaging had told us exist in the passage.

A hypothetical example might serve to clarify these procedures. Assume a passage of narration on a certain topic such as a chapter from a text-book. Assume further that a group of 100 readers is asked to read the passage and to place a slash mark at each point where they think one idea ends and another begins. Different readers will have different numbers of idea units thus marked, naturally. But the best estimate of how many ideas units probably exist in the passage is the average number of units the 100 readers chose. Say the average number of ideas marked in this passage is 20. The question remains, which are the "actual" 20 which the passage contains? The answer is, those the 100 readers had the highest agreement on. Which possible place for a slash mark was most frequently chosen? Next most frequently? And so

on, until the 20 most frequently chosen idea units are determined. The hypothetical passage is now divided into idea units based on readers' perceptions. The procedure is elegantly simple and lets us describe the idea unit constituents of any text based on a group of readers' perceptions. This represents a major purpose of our research which we will continue to refine in practice.

Our first major research question has concerned the relationship between the importance rating of individual idea units and the likelihood of their inclusion in the recalls of students who read the passage. As one might expect, we find a substantial and significant corelation between importance and recall of an idea ($r = 0.39$, $p \leq .001$). This accounts, however, for only 16% of the variance, leaving us to conjecture about the other 84%. We are particularly interested in two kinds of deviations: 1) students failing to report what they know to be important and 2) students tending to report what they know to be unimportant. We are now cataloging aspects of the text and aspects of students' approaches to the text that seem to be related to these two anomalies. We are phrasing our conjectures in the form of hypotheses which we think the tools and procedures we have developed will soon allow us to test.

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